CHARACTERIZATION OF PHOTOINDUCED VALENCE TAUTOMERISM IN A COBALT DIOXOLENE COMPLEX BY FEMTOSECOND M-EDGE SPECTROSCOPY

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Cobalt dioxolene complexes undergoing photoinduced valence tautomerism (VT) are potential candidates for molecular electronic devices. Thermal or photoinduced electron transfer between a dioxolene ligand and the metal center reversibly switch the complex between a paramagnetic or diamagnetic species. A low-spin Co^{II} intermediate is believed to be involved in the photogeneration of the paramagnetic state from the diamagnetic state, but has not been spectroscopically observed yet. Our group has developed a tabletop M-edge XANES spectrometer which generates femtosecond extreme ultraviolet pulses via high-harmonic generation (HHG). M-edge spectroscopy has been shown to be sensitive to changes in oxidation state, spin state and/or ligand field changes at metal centers, and the spectra can be predicted using ligand field multiplet theory. In this work, we will present temperature dependent and time-resolved spectra of a cobalt dioxolene VT compound and highlight the ultrafast electron transfer and spin state changes. The theoretical tools developed to predict and interpret the M-edge spectra of metal-centered excited states will also be discussed. This work demonstrates that HHG-based XUV absorption spectroscopy is an accessible alternative to synchrotron-based X-ray absorption spectroscopy for elucidating the electronic structure and photoinduced dynamics of transition metal complexes.